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Application of Lean Thinking to Minimize Waste at The Warehouse of PT. Aerojasa Cargo

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Abstract: This research aims to identify types of waste and minimize the causes of waste in warehouse operational activities, spanning from the receiving process to the shipment of goods at PT. Aerojasa Cargo Jurumudi warehouse. The problems in the company arise due to non-value-added warehouse operational activities (waste). The major types of waste identified are motion waste, overprocessing, and waiting. The method used is a qualitative method with a lean thinking approach, supported by Value Stream Mapping (VSM) tools and complemented by fishbone diagrams to identify the root causes of waste problems. Research data were obtained through direct observation and interviews. The results show that waste occurs because of a lack of structured task distribution among operators and insufficient availability of material handling equipment. Recommendations for improvement include assigning clear and structured tasks and responsibilities to each employee, evaluating the use of necessary materials, and adding equipment as needed.

Keywords: lean thinking, waste, operational warehouse, movement of goods enhancing productivity, value stream mapping, fishbone

INTRODUCTION

The evolution of the industrial sector currently necessitates industry players to innovate to sustain their businesses amidst intense competition. Every company must be capable of delivering the finest products and services. One strategy to foster the efficiency and effectiveness of a company is to manage an appropriate warehouse system.

A warehouse is a facility specifically designed to store various types of goods or materials, including raw materials for manufacturing processes and finished products ready for customer dispatch. Beyond storage functions, warehouse activities involve a sequence of processes spanning good reception, recording, storage, selection, sorting, labeling, and

shipping.This sequence concentrates on operational activities and the movement of goods executed to support a unit's workflow. (Stephens & Meyers, 2013)

Operational warehouse activities encompass a series of tasks related to the management and operation of storage or distribution warehouses. The goal of warehouse management is to optimize the use of existing resources and employ limited resources to enhance service delivery to customers. Warehouse management involves tasks such as inventory management, inventory control, shipment management, order processing, and the necessary information management for coordinating the movement of goods within the supply chain. (Lambert, Stock, & Ellram, 1998)

The movement of goods encompasses the physical and logistical processes where goods or products are transferred from one location to another in the distribution process. Goods movement is a crucial element in business, production, and logistics operations, involving a series of steps in activities conducted to ensure that goods reach their final destination safely, promptly, and in accordance with customer needs. (Nusantara et al., 2023)

PT. Aerojasa Cargo is a company under the auspices of the Aerowisata – Garuda Indonesia Group. It focuses on its activities in the service sector, including the provision of logistic services, primarily in cargo delivery. The company offers cargo delivery services using air transportation modes, ranging from port-to-port to door-to-door, available throughout Indonesia.

PT. Aerojasa Cargo consistently performs operational processes in accordance with the Standard Operating Procedures (SOP) established. However, issues arise in the inbound and outbound processes in the PT. Aerojasa Cargo warehouse, leading to suboptimal good movement processes. These issues stem from warehouse operational activities that fail to generate added value, commonly referred to as waste. Waste occurs when goods must wait for transportation and handling, excessive use of materials in the packing process, and the inability to ship goods due to overloading. This waste is a result of inadequately structured methods, leading to the absence of standardized time for each activity.

To address these challenges, the application of lean thinking concepts is necessary to enhance efficiency in warehouse operational processes and minimize waste. This research aims to identify the level of waste and determine the root causes of waste in the activities of the PT. Aerojasa Cargo warehouse.

Literature Review

Warehouse

According to (Warman, 2010), a warehouse is a structure that stores various types of goods, including building materials and commercial products. Therefore, a warehouse serves as a storage facility for diverse items, including raw materials, semi-finished products, and finished goods. The purpose of warehouse activities is to efficiently and effectively oversee the movement of goods, including receiving, storage, and retrieval, as well as to provide convenience and accurate inventory information.

Warehouse operations involve good reception, stock control, storage, issuance, packaging, and distribution. All of these activities ensure the availability of appropriate products at predetermined times. It can be concluded that warehousing constitutes the entire process of managing a warehouse or storage facility. Warehousing encompasses planning, organization, stock management, delivery, distribution, security supervision, and all related activities involved in warehouse operations. Warehousing entails a broader concept that includes the physical and administrative management of the warehouse facility. (Bestari & Fatma, 2020.)

Waste

In accordance with Gaspersz (2007), waste refers to any activities within the work process that do not add value to the output (goods and services). In other words, these company activities provide more minor benefits than the costs incurred to support them. According to (Jones, 2003), identifying and eliminating all forms of waste within the production process can enhance efficiency, increase productivity, and improve company competitiveness. Generally, companies implementing this concept experience enhanced product quality, reduced inventory levels (raw materials/materials), decreased production costs, and more efficient and optimal customer order fulfillment. Besterfield, 2013 identified several types of non-value-added waste, including:

1. Defects: This involves product imperfections, labor shortages during the process, rework processes, and customer claims.
2. Waiting: This includes waiting for the arrival of materials, information, equipment, or tools. Workers may observe machines running or stand by for the next process step.
3. Unnecessary inventory: This includes storing inventory beyond the specified warehouse capacity, material damage due to extended storage or rapid depletion, and expired materials.
4. Inappropriate processing: This involves a process or production operation mismatch caused by improper use of equipment or procedural/system operation errors.
5. Unnecessary motion: This encompasses avoidable movements such as components and controls located out of reach, double handling, non-standard layouts, and operator bending.
6. Transportation: This involves wasted time due to the distance between raw material warehouses and machines or the transfer of materials between machines or from machines to finished goods warehouses.
7. Overproduction: This includes producing unordered goods or items beyond the order or sales demand.

In conclusion, waste is an action or activity that results in excessive use of resources, time, energy, and costs, rendering it inefficient, unproductive, and lacking significant value addition in operational activities. Waste within a company can lead to various problems, including financial losses, decreased productivity, and unsustainability.

Lean Thinking

Lean Thinking is an approach that companies adopt to enhance productivity and achieve efficiency, aiming to identify and minimize waste in company operations. Lean focuses on recognizing and eliminating non-value-added activities in design, production, processes, and supply chain management directly related to consumer needs (Dzulkifli et al., 2021).

According to (Putra & Abdul, 2021), lean is a continuous improvement effort to eliminate waste, increase the value-added aspect of products (goods and services), and provide value to customers. (Putu et al., 2013) describes Lean as a business philosophy that minimizes the use of production resources in various company activities through continuous improvement and enhancement efforts. It focuses on identifying and eliminating activities related to design, manufacturing, services, and supply chain management that directly impact customers. In conclusion, Lean Thinking is an approach that companies utilize to improve productivity, efficiency, and the quality of products or services. Therefore, this method is highly suitable for waste reduction.

METHOD

This research employs a qualitative design using the lean thinking method to identify the emergence of waste through direct field observation and interviews. Data collection

involves the application of a Time Motion Study (TMS) using a stopwatch. This section will outline the research framework, from the initial data collection process to data analysis. The research employs a qualitative research design using the lean thinking method to identify the emergence of waste through direct field observation and interviews. Data collection involves the application of Time Motion Study (TMS) with the use of a stopwatch.

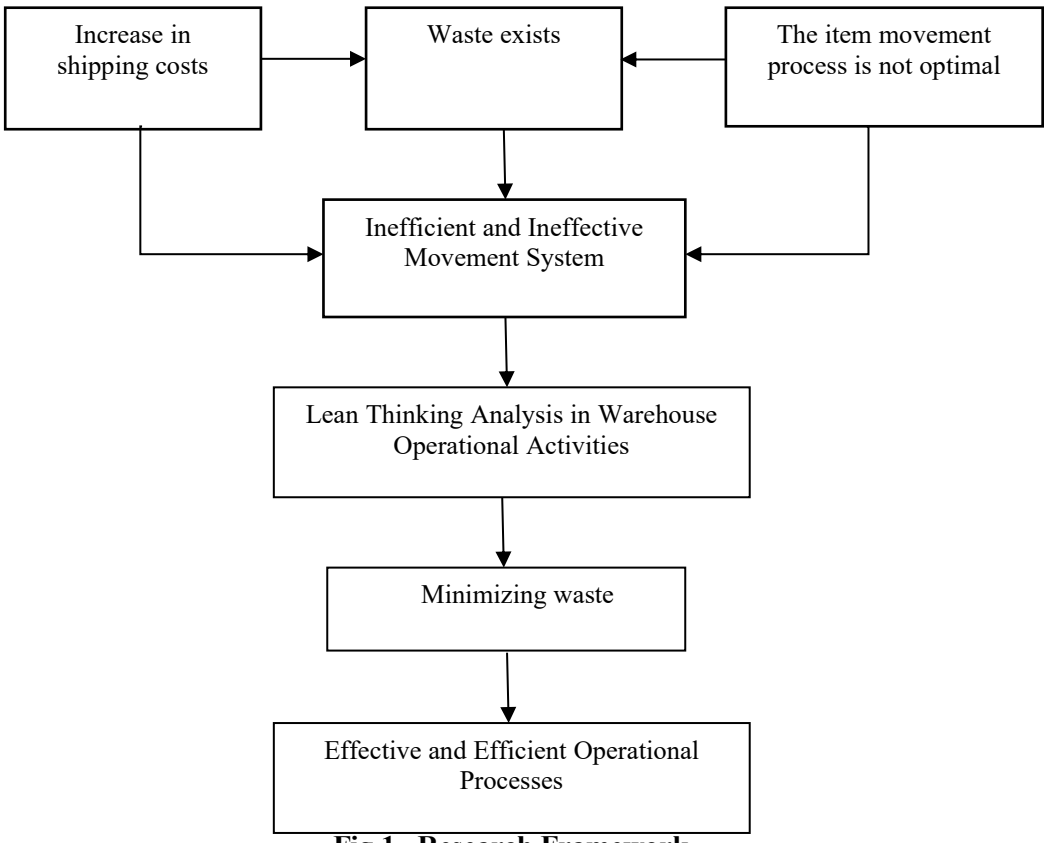

Fig 1. Research Framework

Based on the above research framework, it can be identified that the current warehouse operational processes could be more efficient due to the presence of waste, resulting in suboptimal goods movement processes that lead to unproductive operational activities. Thus, a lean thinking analysis is needed to minimize the occurring waste. The goal is to minimize waste and enhance the warehouse's operational processes for optimal performance.

Value Stream Mapping (VSM)

Value Stream Mapping (VSM) is a tool used to illustrate the movement of material and information in a value stream. VSM assists companies in recognizing and understanding the stages required to create a product or service from the initial to the final stage, identifying occurring waste, and planning necessary improvements to enhance the efficiency and quality of the company's business processes. (Noto & Cosenz, 2021)

In conclusion, it can be concluded that Value Stream Mapping (VSM) is a tool or technique employed within Lean Thinking to analyze, document, and visualize the flow of value in a business or production process. VSM assists companies in identifying and understanding the necessary steps to generate products or services, from inception to completion. Furthermore, it facilitates the identification of waste and the planning of necessary improvements to enhance the efficiency and quality of the company's business processes. (Parihar et al., 2012)

Fishbone

The Fishbone diagram is a visual tool used to analyze and identify factors that can cause a problem. It illustrates various causes that influence a process by separating and connecting one cause to another. This diagram functions to identify and investigate the cause-and-effect of a problem or seek factors that can drive improvement or enhancement (Eviyanti, 2021). According to Heizer & Rende in (Barry et al., 2023) this diagram is also known as a fishbone chart, beneficial for showing the main factors impacting quality and having consequences on the investigated problem. In addition, the diagram provides a more detailed view of the factors influencing and impacting the main factors, which are visible through the arrows forming the fishbone structure.

RESULT AND DISCUSSION

The warehouse of PT. Aerojasa serves as a storage facility for finished goods to meet consumer needs. There are four teams involved in these activities, namely the checker team, reservation team, data entry team, and processing team. In the warehouse processes, PT. Aerojasa Cargo has already implemented a standardized barcode system. By utilizing the barcode system, all operational warehouse activities are interconnected with all teams working within the warehouse. The operational activities of PT. Aerojasa Cargo's warehouse consists of two main activities: the goods receiving and shipping.

Good Receiving and Shipping Processes

The goods receiving process is where PT. Aerojasa Cargo receives goods from distributors on the basis of customer demands. At this stage, each item is handled differently during the packaging process. If a larger quantity of goods arrives, it takes more time due to manual handling processes and the limited availability of equipment, compared with a smaller quantity, which allows for a quicker and easier handling process.

The shipping process involves delivering goods from the Aerojasa warehouse to the aircraft and ultimately to the end customer. During the shipping process, PT. Aerojasa makes cargo reservations in advance to secure space on the aircraft. The reservation team is responsible for booking the aircraft and creating the Air Waybill (AWB) so that the goods can be shipped. Once the AWB is issued and the goods are ready for handling, they are prepared for loading onto trucks. The Air Waybill (AWB) is a document used in the shipping and logistics industry to document air cargo shipments.

An analysis of each step in the inbound and outbound activity flow was conducted using the Time Motion Study (TMS) method with a stopwatch. The aim is to observe the waste that occurs during the goods receiving and shipping processes.

Table 1
Cycle Time of the Inbound to Outbound Process

Activity	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Avarage (minute)
Receiving	49 min	41 min	44 min	43 min	55 min	36 min	51 min	45,6
Packing & Labeling	67 min	61 min	66 min	50 min	73 min	55 min	53 min	60,7
Storage	22 min	18 min	21 min	18 min	28 min	16 min	21 min	20,5
Picking	18 min	21 min	16 min	20 min	15 min	19 min	15 min	17,7

Table 1. outlines the inbound and outbound activities in the warehouse of PT. Aerojasa Cargo. Subsequently, a Value Stream Mapping (VSM) diagram was created to delineate the ongoing flow of information and materials, illustrating the incoming process based on the conducted analysis. The following is the value stream mapping based on the analysis performed:

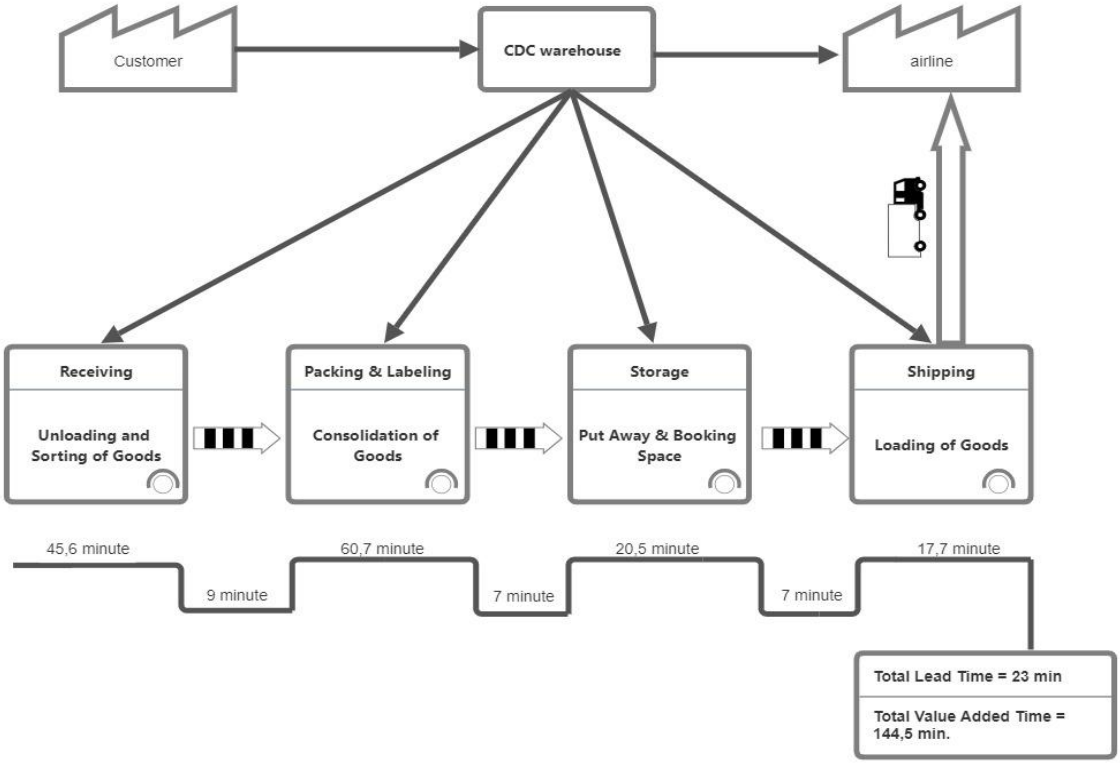

Fig 2. Value Stream Mapping (VSM) for Inbound and Outbound Activities

Figure 2 illustrates the Value Stream Mapping (VSM) from the process of receiving goods to the shipment of goods. In the flow of Value Stream Mapping, it starts from the left side with the VSM symbol, representing the customer. This indicates that the customer sends goods to the Cargo Distribution Center (CDC) warehouse. The CDC warehouse comprises four operational warehouse processes, starting with the unloading and sorting process, which takes 45.6 min. The extended duration of this activity is attributed to manual unloading, which leads to prolonged processing time and potential human errors during the sorting process, causing misplacement of items. This misplacement contributes to the wastage of material movement. The subsequent packing and labeling processes require 60.7 min, revealing a type of waste known as overprocessing. This is suspected to be caused by employees using excessive materials, such as an overuse of bubble wrap, which does not comply with the dimensional requirements of the items. Meanwhile, the storage and picking process takes 38.2 min, and the identified waste is waiting, resulting from limited material handling equipment, which prolongs the picking process.

Process Activity Mapping

Detailed activity specifics for the inbound process and activities in the actual Value Stream Mapping are identified more comprehensively in terms of time calculations and activity classifications. A detailed activity breakdown for the inbound process is shown in Table 2.

Tabel 2
Process Activity Mapping Actual

No.	Activity	Activity Details	Assigned Workers	Time (minutes)
1.	Receiving	Checking the quantity of goods and documents	1 head of the warehouse	3 minute
		The process of entering product codes to create connotes labels	2 members of the checking team	7 minute
		The unloading process	9 members of the processing team	15,6 minute
		Sorting items based on the destination city	9 members of the processing team	20 minute
2.	Packing & Labeling	The process of moving items to the staging area	9 members of the processing team	9 minute
		Applying conote labels to each item		11 minute
		Box assembly		4 minute
		The process of consolidating items into cardboard boxes		22 minute
		Labeling process		7 minute
		The process of cutting bubble wrap		4 minute
		The process of packaging items using bubble wrap		12,7 minute
No.	Activity	Activity Details	Assigned Workers	Time (minutes)
3.	Storage	The process of moving items to the reservation area	9 members of the processing team	7 minute
		The process of transferring from bagging to the reservation team	1 members of the checking team	3 minute
		The process of flight booking and airwaybill creation	2 members of the Reservation team	10 minute
		The process of labeling the airwaybill number	2 members of the Reservation team	7.5 minute
4.	Picking	The process of moving items to the unloading reservation area	9 members of the processing team	7 minute
		The process of handing over the Airwaybill to the driver	1 head of the warehouse	4 minute
		Goods loading process	9 members of the processing team	13,7 minute

The process flow and associated time information required for a single inbound activity are displayed in the Value Stream Mapping diagram. In this inbound activity process, there are four main activities: receiving goods from the supplier, the checker team examining the waybill to ensure conformity with the received goods, the processing team unloading goods from the truck and placing them on pallets, followed by the sorting process to group items based on the destination city. Subsequently, the packing process provides physical protection to prevent damage during shipment and ensures the safety of the goods. After

packing, labeling is performed by affixing a label to the packaging containing information such as the sender's and recipient's addresses, destination address, waybill number, weight, and dimensions. Once the packing is complete, the items are placed in the staging area. The next steps involve booking a cargo plane to reserve cargo space, followed by the picking process, collecting the items, and then shipping them to the final destination.

Fishbone Diagram

In the operational process, various types of waste were identified, including waste of motion, overprocessing, and waiting. The root causes of these waste types were analyzed using the fishbone diagrams shown in Figures 2, 3, and 4.

The fishbone diagram results revealed three causative factors for waste of motion. First, the man factor was identified as unstructured task distribution, which led to a decline in warehouse operational efficiency. The varied skills of each employee and the increased workload for each employee contributed to this inefficiency. Second, the "Method" factor highlighted manual handling in the warehouse operational activities, particularly in the loading and unloading processes, and a lack of adherence to Standard Operating Procedures (SOP). Lastly, the "Material" factor indicated a shortage of available material handling equipment, causing challenges in the movement of goods. These three factors collectively resulted in time-related waste during warehouse operational activities.

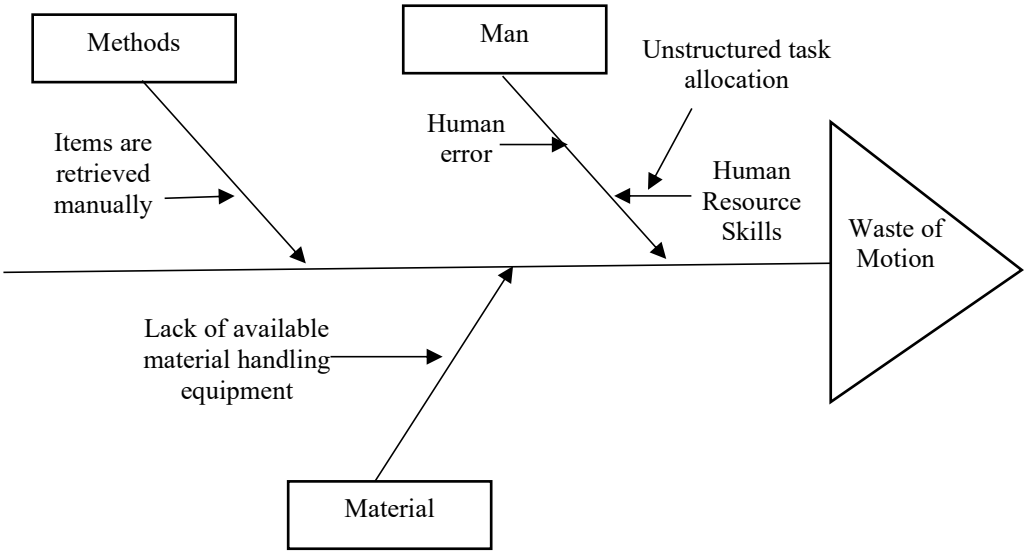

Fig 3. Fishbone Diagram: Waste of Motion

Solution and Improvement Strategies for Waste of Motion:

1. Skill Shortage in Human Resources (HR): Due to the unstructured task distribution, a clear planning of task allocation is implemented, defining roles and responsibilities for each employee. Task assignments are based on individual skills to ensure efficient task completion. In addition, training and development programs are provided to enhance the efficiency and effectiveness of employees engaged in warehouse operations, contributing to minimizing waste of motion.
2. Human Error in Sorting Process: To address errors in placing items during sorting, improvements involve ensuring clear labeling for every item and storage area. This may include the use of labels or an effective identification system to avoid mistakes. In cases of recurring errors, a review and update of the work procedures may be considered.
3. Manual Picking of Items: The manual picking process is optimized by implementing a Warehouse Management System (WMS). This technology optimizes item storage arrangements, ensuring efficient and easily accessible

locations. The use of technology, such as barcode systems, is considered to expedite the picking and searching processes, thereby enhancing warehouse operational efficiency and minimizing waste of motion.

4. Insufficient Material Handling Equipment: Addressing the shortage of available material handling equipment involves adding the required number of hand pallets in accordance with warehouse needs. Routine maintenance is implemented to prevent unforeseen damages or equipment failures that could disrupt operations and extend the lifespan of the equipment for long-term durability.

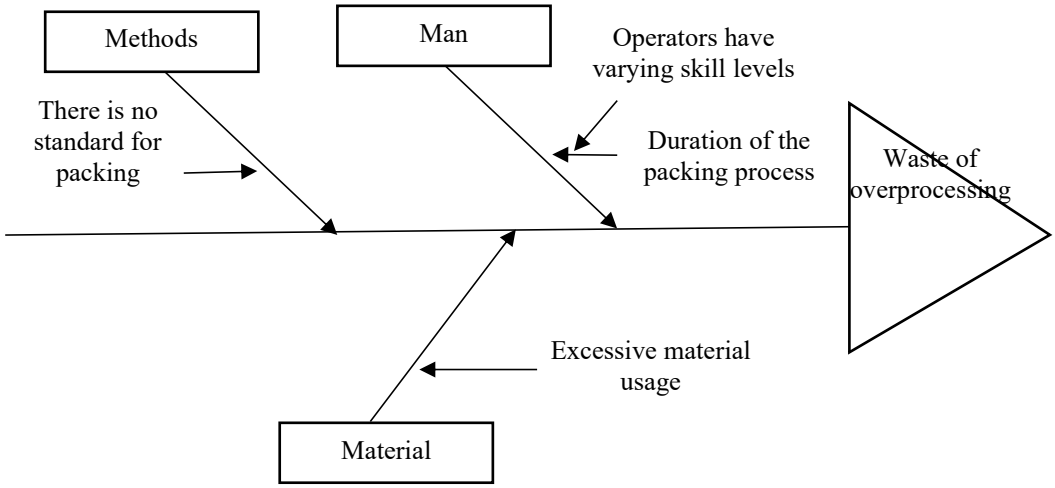

Fig 4. Fishbone Diagram Waste of Overprocessing

The results of the fishbone diagram for waste of overprocessing reveal three causative factors during the packing process. First, the human factor contributes to the waste due to the prolonged time taken for packing, which is influenced by varying skill levels among operators. This leads to time-related wastage. Second, the method-related factor causes waste due to the lack of defined methods in the packing process, which impacts the material factor. This, in turn, results in material wastage during packing and an increase in the dimensional aspects of the items, subsequently escalating costs. Proposed Solutions for Waste of Overprocessing:

1. Prolonged Packing Process: To address the varied skill levels among operators leading to extended packing times, a solution involves conducting training sessions for warehouse staff to enhance their skills and proficiency in performing tasks. Ensuring that each employee understands the Standard Operating Procedures (SOP) during the packing process can significantly reduce time-related waste.
2. Lack of Standardized Methods: The absence of standardized methods in warehouse operations can be rectified by establishing clear procedural standards and creating explicit packing standards for each product category.
3. Excessive Material Usage: To mitigate the overuse of materials, the solution includes the creation and implementation of Standard Operating Procedures (SOP) to optimize the packing process and reduce material waste.

The fishbone diagram results reveal three influencing factors contributing to the waste of waiting in the operational warehouse activities. This waste is primarily due to a lack of meticulousness during the sorting of goods, where the random placement of items leads to an extended duration in the packing process while searching for items. Additionally, the absence of a schedule providing information about the arrival of goods creates uncertainty in delivery times, as there is no estimation of when the items will arrive. Furthermore, the limited availability of material handling equipment necessitates operators to take turns in their usage.

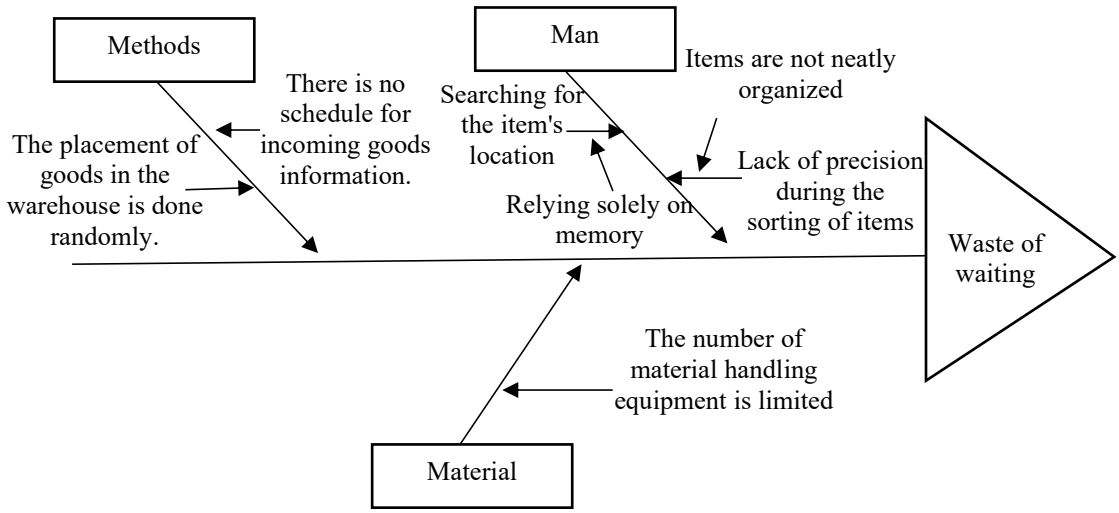

Fig 5. Fishbone Diagram Waste of Waiting

These factors collectively result in goods being undelivered, requiring waiting time due to an excess of weight and causing time-related wastage in the operational warehouse processes. Proposed improvements for the waste of waiting in warehouse operational activities include:

1. Lack of Meticulousness in Sorting Goods: The cause, uneven placement of goods, can be addressed by organizing and implementing a systematic arrangement of items within the warehouse. This involves setting up an organized system of goods placement to minimize difficulties in locating items and reduce the time spent searching. Utilizing a sorting system based on criteria such as city locations can facilitate easy searching and item placement.
2. Reliance on Memory for Locating Goods: To address this issue, where reliance on memory leads to difficulties in locating goods, implementing a digital recording system is recommended. This can be achieved through inventory management software or mobile applications that allow for systematic recording of the location of each item. For example, scanning barcodes or QR codes on each item and digitally recording their locations can significantly ease the tracking process.
3. Random Placement of Goods in the Warehouse: To address the issue of random placement of goods, which is attributed to the absence of scheduled information on the arrival of goods, the proposed solution is to establish a routine schedule for receiving and placing items. Ensuring accessibility and understanding of this schedule by all relevant parties is crucial for effective implementation and improvement in the waiting-related aspects of warehouse operational activities.

CONCLUSION

Summary

Based on the fishbone analysis and the conducted research, three types of waste were identified waste of overprocessing, waste of waiting, and waste of motion. The causes are as follows:

1. From the fishbone diagram, three types of waste were identified: motion, overprocessing, and waiting.
2. Waste of motion is caused by unstructured employee task allocation, leading to repetitive movements due to a lack of coordination. Another cause of waste is the random placement of items, which does not align with the designated areas.

3. Overprocessing waste is a result of excessive material usage, particularly excessive use of bubble wrap, leading to waste and increased production costs, as well as generating more waste.
4. Waste of waiting is attributed to the lack of necessary tools and equipment to complete warehouse operational tasks. Consequently, if the required tools and equipment are limited, warehouse employees must wait their turn to use them. Additionally, equipment breakdowns result in delays, as employees wait for repairs or replacements.

Recommendations

Based on the research conducted by the researchers, we have several recommendations:

1. Recommendations for the company to minimize the three types of waste include assigning clear and structured tasks and responsibilities to each employee and ensuring that all employees adhere to standard operating procedures. This includes organizing and placing items neatly for easy retrieval, evaluating the use of bubble wrap according to the dimensional needs of the items, and implementing material usage standards to reduce material waste. To avoid waiting times, it is essential to acquire and maintain the necessary tools and equipment, as well as implement technology in the warehouse to reduce waste, prevent overprocessing, and improve productivity and efficiency, allowing the company to remain competitive in the current industry.
2. Recommendations for future research involve the company implementing the proposed improvements provided in this study to minimize waste in PT. Aerojasa's warehouse. Subsequent research can focus on waste elimination and conduct a more in-depth evaluation of the effectiveness of Lean Thinking implementation.

Implications

The results of this study have valuable implications for readers as information, and for the company, they can be utilized as input to improve warehouse operational activities, thereby enhancing efficiency in warehouse activities. This can reduce storage costs and improve warehouse space utilization efficiency by identifying and reducing non value added activities. By focusing on minimizing waste in the picking and packing processes, optimization can be achieved, leading to a reduction in the time required to pack orders and resulting in faster completion times. Lean thinking can reduce waiting time during operational processes, thereby increasing productivity and potentially reducing unnecessary costs in warehouse activities.

Research Limitations

In the process of conducting this research, there are limitations that may have influenced the research outcomes, including:

1. Limitations in research time and the researcher's capabilities that may have impacted the research's full potential.
2. This study only examines the application of lean thinking in the operational activities of PT Aerojasa Cargo's warehouse.
3. Limitations in the author's knowledge in composing this paper, necessitating further examination in the future.
4. Constraints related to the data obtained during the research, which may have hindered the research's full potential.

The limitation of conducting the study only at one warehouse location of PT. Aerojasa Cargo implies that the findings may not be directly applicable to different situations or other warehouses

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